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(54) Custom fitting assembly for helmet with protective hood

(57) A protective system for aircrew comprises an outer helmet and an inner helmet (20). The inner helmet includes a protective hood (70) molded to the contours of the interior of an aircrew helmet. A brow pad (30) and a support panel (40, 50) are located within the protective hood (70). A custom fitting system, that adjusts the position of the support panel (40, 50) relative to the outer helmet, is located outside the hood. The custom fitting system is pivotally connected to the support panel (40, 50), with the protective hood (70) sealed around the pivotal connection. The brow pad (30) and support panel (40, 50) lift the hood off the wearer's head, providing a gap to circulate ventilating air.

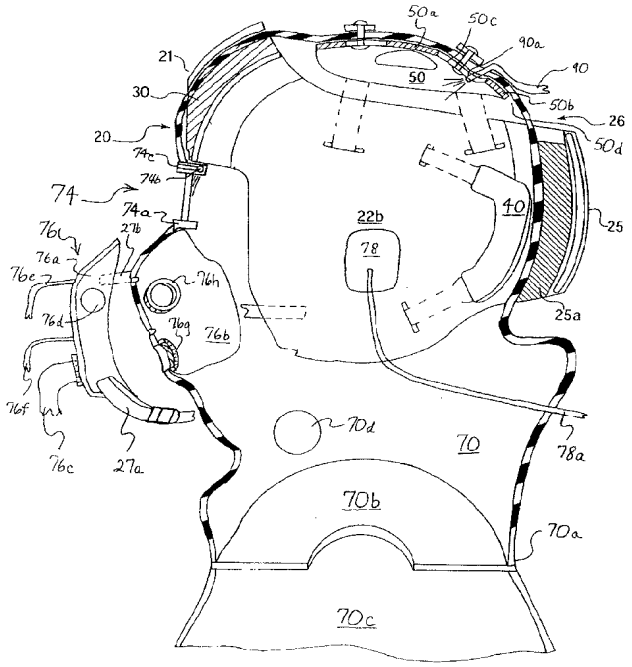

Fig. 2B

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Description

[0001] The invention relates to a custom fitting assembly for a helmet equipped with a protective hood. The system is particular suited for use with helmet mounted devices which support military air and ground operations.

[0002] In general, helmets are designed to meet requirements for comfort, stability, and head impact protection during flight, egress and ejection, and to fit an anthropometric range of heads. With the advent of helmet mounted devices (HMDs) an increased demand for optical stability was required to keep the HMD in the operator's field of view. This created various designs of inner liners and improved suspension systems to meet the comfort, stability and weight bearing requirements of the many HMDs.

[0003] Improvements in electro-optics technologies promised to transfer aircraft mounted head up displays and HMD imagery to the inner surface of the helmets visor or to other optical display combiner or device. With new Helmet Mounted Display (HMD) technologies comes a new and even tighter requirement for optical stability. Current helmets have been used to launch these new technologies with little success. The weights and center of gravity of new HMD systems displace the helmet out of the "eyebox" thereby negating the HMD's operational effectiveness as well as causing aircrew fatigue, neck strain, and during ejection possible severe injury and death.

[0004] An example of a prior art design is described in U.S. Patent 5,584,073. A serious drawback with such platform is that to achieve a high level of stability, the suspension had to be tightened to the point of wearer discomfort. While the suspension system was tight it still swayed under "G" loading with HMD weights. Due to the narrow headband, the load bearing areas around the head created numerous areas of discomfort, known as "hot spots". Additionally, each HMD system requires exact and repeatable placement of the image in front of the wearer's eyes, which must be maintained during the entire mission and over many missions. Designers concluded that meeting such criteria with existing systems could not be practically achieved and would require an impractical number of helmet sizes to properly fit a large anthropometric head population.

[0005] Accordingly, it would be desirable to provide an inner helmet assembly in just a few sizes which could be easily custom-fitted to military personnel for use with various outer helmet systems for a variety of modem combat applications. Such an inner helmet would figuratively lock onto the wearer's head thereby insuring reproducible alignment of the "eyebox" to the eventual HMD.

[0006] The preferred embodiments of the invention therefore provide a helmet fitting assembly in one or two sizes with custom-fitted inserts that can be adapted to various helmets. The preferred embodiments allow easy positioning of the helmet with positive locking devices. The preferred embodiments provide an insert which is molded or formed in situ to conform to a portion of the wearer's head. The preferred helmet is equipped with a hood that provides protection against chemical agents and biological agent, as may occur during chemical or biological warfare or industrial accidents.

[0007] These and other related features are provided by a semi-rigid suspension system of independent components which contacts the head over large surface areas. The system includes a custom-contoured component and positive lock components which cooperatively allow repeated engagement of the desired design eye position.

[0008] The preferred embodiment of the system revolves around an inner helmet comprising a front forehead dome and side sections. A semi-rigid rear panel engages the wearer's nape and has adjusting straps which extend generally forwardly to engage positive locking clips located on the inner helmet side sections. The inner helmet is positioned in the fore and aft directions by the rear panel adjusting straps. A contoured pad then supports the forehead dome on the user's forehead. The contoured pad includes an inner comfort layer, a primary layer which is custom fitted in situ, and an outer impact absorbing layer. Because the primary layer is essentially a mold of the wearer's forehead it always seats in the same position.

[0009] A semi-rigid crown pad has adjusting straps which extend generally downward to engage positive locking clips located on the inner helmet side panels. The inner helmet assembly is suspended from the crown pad via the straps which are adjusted to bring the inner helmet to the desired vertical position. The inner helmet is restricted from upward movement by a chin strap or breathing mask.

[0010] The components of the helmet fitting assembly are adjusted along the horizontal and vertical axes to position the wearer's eyes in the proper orientation and distance from the ultimate display. In use the helmet fitting assembly also resists forward rotation caused by the weight of the display systems located in front of the wearer's forehead within the helmet. Forward rotation is characterized by the forehead dome sliding down while the rear portion of the helmet rides up. These forces are resisted by the brow pad which is molded to a particular part of the forehead, the nape panel, and by the chin strap or breathing mask which opposes any tendency of the rear part of the helmet to pivot away from the wearer's chin.

[0011] It can be seen that we have met the various objects of the invention by providing a custom molded insert which complements the positive lock components used for alignment. The semi-rigid crown pad and nape panel are strong, lightweight and conformable to individual sizes and shapes. All inserts are designed to distribute weight and stresses over large surface areas avoiding sensitive regions of the head. The inserts work

in conjunction with the chin strap or breathing mask and nape strap to resist pivoting forces thereby locking the helmet in its desired position.

[0012] In the accompanying drawings to which reference is made in the instant specification and which are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in various views:

FIG. 1 is an exploded view of the preferred embodiment showing an outer helmet separated from an embodiment of an inner helmet which includes the fitting assembly according to the invention.

FIG. 2A is a cross-sectional view of the inner helmet taken along the line 2-2 from FIG. 1.

FIG. 2B is a cross-sectional view similar to FIG. 2A showing the protective hood according to the invention.

FIG. 3A is an enlarged view of the front brow pad taken from FIG. 2A.

FIG. 3B is a front side elevational view of the brow pad illustrating a foaming operation for custom fitting the brow pad to the wearer's forehead.

FIG. 3C is an enlarged view similar to FIG. 3A showing the protective hood in relation to the brow pad.

FIG. 4A is an enlarged view of the nape strap taken from FIG. 2A.

FIG. 4B is a front side elevational view of the nape strap.

FIG. 4C is an enlarged view similar to FIG. 4A showing the protective hood in relation to the pivotal connection of the support panels.

FIG. 5 is a top plan view of the crown pad taken along the line 5-5 from FIG. 2A.

FIG. 6A is a cross-sectional view of a retention clip engaging a strap taken along the line 6a-6a from FIG. 2.

FIG. 6B is a further view cross-sectional view of the retention clip taken along the line 6B-6B from FIG. 6A.

[0013] Referring now in detail to drawings, and in particular FIG. 1, there is shown an outer helmet 10 separated from an inner helmet 20. Outer helmet 10 may, for example, be formed of ballistic material of any suitable type known to the art to afford the wearer protection against injury from flying fragments and the like. Outer helmet 10 may consist of a basic protective helmet for infantry, a standard helmet for air crew provided with visors, or an advanced helmet for air crew provided with HMD technologies. Inner helmet 20 may be permanently attached within outer helmet 10, for example, by screws or adhesives. Alternatively inner helmet 20 may be clipped, latched or otherwise removable secured within outer helmet 10, for example by an interchangeable latch assembly described in a commonly-owned, copending patent application Serial No. 09/640,442 filed on August 17, 2000. Total weight for the inner helmet and on HMD equipped outer helmet is in the order of 4 1/2 lbs.

[0014] Inner helmet 20 is a rigid frame made of a strong yet lightweight material, for example, graphite or fiberglass. Inner helmet 20 is characterized by a broad forehead dome 21, side sections 22a and 22b, a rear panel 25 and a crown aperture 26. Side section 22a includes a first pair of retention clips 23a and 23b and a second pair of retention clips 23c and 23d. A similar set of retention clips are mounted onto side panel 22b. A chin strap 19 extends between the lower portions of side panels 22a and 22b.

[0015] Referring now to FIG. 2A side panel 22b is shown with a first pair of side panel slots 24a and 24b disposed immediately rearwardly of the first pair of retention clips, and a second pair of side panel slots 24c and 24d disposed immediately above the second pair of retention clips. A crown pad 50, which will be described in greater detail below, includes adjusting straps that extend through slots 24c and 24d and into respective retention clips. These adjusting straps permit vertical positioning of inner helmet 20 relative to the crown of the wearer's head. A breathing mask may be attached to side panels 22a and 22b via adjustable length straps 27a. While not shown for the sake of clarity, the central portion of each side panel may comprise a depression for accommodating ear phones.

[0016] Adjacent the interior of forehead dome 21 is a brow pad 30 which will be discussed in greater detail below in connection with FIGS. 3A and 3B. A rear pad 25a of impact absorbing material is attached to the interior of rear panel 25. Interior of rear pad 25a is a nape panel 40 which will be discussed in greater detail in connection with FIGS. 4A and 4B. In use, the adjusting straps of nape panel 40 are employed to set the fore and aft position of inner helmet 20 with respect to the nape of the wearer's neck. Brow pad 30 is subsequently fitted to the contours of the wearer's forehead. Points within brow pad 30, nape panel 40 and chin strap 19 or breathing mask 27 form the apices of an imaginary triangle 28. Upon installation of brow pad 30, leg 28a of triangle 28 assumes a fixed length. When tightened, chin strap 19 or breathing mask 27 essentially fixes the distance of legs 28b and 28c. The significance of the fixed triangle geometry is as follows.

[0017] The straps of nape panel 40 and crown pad 50 may be adjusted to establish a particular exit pupil distance for an outer helmet mounted display (HMD). The position is retained by brow pad 30 which fills the entire space between forehead dome 21 and the wearer's forehead. An outer helmet mounted display typically adds significant weight to the front portion of the helmet. Such weight is evenly distributed across large surface areas via brow pad 30 and crown pad 50. The moment of this forwardly-mounted weight generally urges forehead dome 21 downwardly over the wearer's eyes. Since leg 28a is of a fixed length, such movement would require nape panel 40 to pivot counter-clockwise. How-

ever, since leg 28b is of fixed length the torque applied to nape panel 40 is resisted by chin strap 19.

[0018] FIG. 2B is another cross-sectional view showing a protective hood 70 that is completely integrated with the components of the custom fitting assembly. The hood forms a protective bubble around the head. With the introduction of chemically- and biologically-filtered breathing and ventilation air into the hood, aircrew can safely operate, and exit their vehicles, in hostile environments.

[0019] FIG. 2B illustrates the positioning of protective hood 70 with respect to the nape panel 40 and crown pad 50, both of which shall be generically referred to as support panels. Brow pad 30 is first fitted and then placed inside hood 70. Nape panel 40 and crown pad 50 are also placed inside hood 70 with their straps located outside hood 70. Hood 70 is sealed around the pivotal connection between the support panels and their straps, as will be described in further detail below. The straps are shown in dotted line indicating that in the view of FIG. 2B they are behind hood 70.

[0020] To seal across the open front of the helmet, there is provided a visor 74 having a visor periphery 74a. A visor duct 74b is disposed within periphery 74a and is fed ventilating air through the front or side of visor 74, for example, at a location 74c outside the hood. Below the visor is a respiration system 76 having the following conventional components: a stiff outer shell 76a; a rubber inner facepiece 76b; a breathing air supply hose 76c; an exhalation valve 76d; a microphone cable 76e; a drink tube 76f; and adjustable length straps 27a and 27b removably coupling outer shell 76a to helmet side sections 22a and 22b. The hood is layered between outer shell 76a and inner facepiece 76b. Components 76c, 76d, 76e and 76f pass through holes in the hood and are secured to inner facepiece 76b, effectively clamping the hood between facepiece 76b and outer shell 76a. Hose 76c and the tubular portion of valve 76d may be secured to facepiece 76b with threaded nuts 76g and 76h, for example. Any openings between the holes and the components are filled with an appropriate sealant.

[0021] A pair of earphones 78 are placed inside the hood, whereby the hood provides increased attenuation of external ambient noise allowing improved communication. The earphones have a communications cable 78a which passes through a hole in the hood. Any opening between the hole and cable 78a is filled with an appropriate sealant. Further down, hood 70 has a lower edge 70a near which is attached a neck dam 70b. Optionally, a shoulder shroud 70c may be attached onto lower edge 70a. Neck dam 70b is an air barrier preventing exchange of air between the head cavity and the atmosphere or the lower portion of a flight suit or other garment. A dump valve 70d is located above neck dam 70b for releasing excess pressure from within the head cavity. Shroud 70c may be attached to the flight suit or other garment with a slide fastener or simply tucked inside. Hood 70 is made from a chemically resistant and biologically resistant material, like rubber or butyl rubber. The hood is molded to the contours of the interior of the helmet.

[0022] Referring now to FIGS. 3A and 3B, brow pad 30 is shown comprising an outer pouch 31 equipped with a closeable flap 31a. Pouch 31 is removably affixed to the inner surface of forehead dome 21, for example, by hook and loop fasteners or other suitable means. Pouch 31 is made from a material which has characteristics of durability and comfort when contacting the wearer's skin, e.g. leather or other suitable materials. Within the pouch there is an outer liner 32 made of an impact absorbing material, for example, polystyrene, which conforms to the interior of forehead dome 21. There is also an inner layer 34 made of compressible, comfort material, for example, foam rubber. Once nape panel 40 and crown pad 50 are adjusted to the proper exit pupil, the interior of pouch 31 is filled with a liquid foaming agent which expands and solidifies to conform to the contours of the wearer's forehead and the outer liner 32. As can be seen in FIG. 3B an expandable foam may be used wherein the foaming agent in liquid form 33 is injected or poured into the interior of pouch 31 and expands to fill the cavity. A minimally exothermic polyurethane foam having a relatively fast rise time may be used, for example, foams made from polyether polyol resin combine with pre-reacted diphenylmethane diisocyanate.

[0023] In FIG. 3C, protective hood 70 is shown between forehead dome 21 and brow pad 30. Brow pad 30 is first fitted, as described above, in the absence of hood 70. Brow pad 30 is then placed inside hood 70 and attached with a hook and loop fastener to the hood 70 instead of forehead dome 21.

[0024] In FIG. 4A, nape panel 40 is shown comprising a semi-rigid frame 41 made, for example, from a composite resin. Very thin, flexible composite resin layers are laminated together resulting in lightweight, yieldable panels. Interior of frame 41 is a comfort layer 42 made from a compressible material, for example, foam rubber. Further interior is a cover layer 43 made from a comfortable, durable material, for example, leather. Cover layer 43 holds comfort layer 42 in place by extending through apertures 44 or around the outer perimeter where its edges are adhered on the exterior side of frame 41. FIG. 4B shows apertures 44 along with straps 46a, 46b, 46c and 46d which are attached respectively to four quadrants of nape panel 40 via pivoting connection points 47a, 47b, 47c and 47d.

[0025] FIG. 4C shows the pivotal connection between the support panels and their straps in detail. A portion of comfort layer 42 is removed and a hole is formed in frame 41 to accommodate a threaded female post 80 which terminates at its left side in a retention plate 80a. Hood material 70 is fitted around post 80 with any openings being filled by an appropriate sealant. Strap 46 is pivotally connected to post 80 via screw 46e. Hence, the pivotal connections for both support panels are main-

tained with the hood material completely sealing the support panels therein. The benefit of this configuration is that the support panels, as well as the brow pad, serve to lift the hood material off the wearer's head providing greater comfort. This configuration also maintains the contact surfaces between the brow pad and the wearer as well as between the support panels and the wearer. Therefore, the wearer's head can be completely sealed against the environment while maintaining the reproducible alignment of the eyebox, which is critical for HMD systems.

[0026] Referring again to FIG. 2B, this lifting of the hood results in a gap 50c between webbing strips 50a and 50b of the support panel or a space 50d adjacent the support panel. A duct 90 having an exhaust vent 90a directed toward gap 50c or space 50d is provided. Duct 90 extends through a hole in the hood. Any spaces around the hole are filled with an appropriate sealant. Ventilating air is provided to duct 90 to cool the wearer's head.

[0027] As can be seen in FIG. 5 crown pad 50 has a similar construction to nape panel 40 including a semi-rigid frame 51, a comfort layer similar to 42 and a cover layer similar to 43. As can be seen from this top plan view, the cover layer has edges 53a and 53b which extend through apertures 54 before being adhered on the exterior surface of frame 51. Each of the quadrants 55a, 55b, 55c and 55d includes a strap 56a, 56b, 56c and 56d pivotally attached to frame 51 via screws 57a, 57b, 57c and 57d. The apertures create web-like strips in panel 40 and pad 50 that extend from the adjacent quadrants out to the strap connection points. This web-like configuration allows each quadrant to conform to the contours of the wearer's crown and nape as the straps bend to extend through the side panel slots in the inner helmet. In other words, the straps and the connection points of FIGS. 4B and 5 have a further independent degree of flexibility into and out of the page.

[0028] FIG. 6A shows an exemplary bendable, plastic strap extending initially through a side panel slot 24 formed within side panel 22a or 22b and further through clip frame 60 made of rugged plastic. Mounting screws 61 secure clip frame 60 to the exterior of side panel 22. Extending outwardly from clip frame 60 is a cantilevered retention arm 62 having a fixed end 62b and a free end 62c with downwardly extending wedges 62a therebetween. Locking element 63, as can be seen more clearly in FIG. 6B is slideably mounted to clip frame 60. Locking element 63 is slideable in direction 62d from a position adjacent rear stop 62e, over detent 62f, to a position adjacent front stop 62g. Ordinarily the free end 62c of cantilevered retention arm 62 is free to rise upwardly as wedges 62a ratchet over corresponding wedges 58 on the strap. Once the final adjusted position is obtained, locking element 63 is slid to its left most locking position whereby the free end 62c is prohibited from riding upwardly to lock the strap in position. In a practical embodiment, wedges 58 on the strap and arm were spaced 2mm apart.

[0029] FIG. 2 shows a positioning fixture 29 with a reference point 29a. Positioning fixture 29 is dimensioned and configured to align reference point 29a on the exact line of sight of the ultimate display. The crown pad straps and nape panel straps are adjusted in 2mm increments to locate reference point 29a directly in front of the wearer's eyes at a predetermined distance. If a strap is inserted too far through clip 60, free end 62c is raised and the strap is retracted. Once aligned, locking elements 63 are moved to their locking positions over free ends 62c. While maintaining the aligned position on the wearer's head, brow pad 30 is filled with the appropriate amount of foaming agent. The resulting foam 33 expands to fill the gap and press the head firmly against nape panel 40. Brow pad 30 and nape panel 40 are generally diametrically opposed. Accordingly, the inner helmet may be easily donned and doffed while simultaneously reestablishing the exact eyebox alignment every time. Upon tightening chin strap 19, the inner helmet assembly becomes locked in position on the head. Centrifuge testing was performed with head movements up to 4G and forwardly-positioned stationery head positioning up to 9G. Overall the approximately 4 1/2 lbs. complete inner/outer helmet was displaced a maximum of 4mm with the average for 10 aircrew between 1.5 and 3mm.

[0030] It will be seen that we have provided a lightweight inner helmet with conformable panels and a complementary contoured pad that can be easily custom fitted to a large population. The helmet fitting assembly effectively distributes weight and resists displacement forces by locking the assembly to the head over large surface areas. The positive lock retention system and molded brow pad insure reproducible alignment to the eyebox thereby meeting critical requirements for HMD utilization.

[0031] It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims. It is further obvious that various changes may be made in details within the scope of the claims without departing from the spirit of the invention. It is, therefore, to be understood that the invention is not to be limited to the specific details shown and described.

Claims

1. A system for adjusting an enclosed support panel comprising:

   a helmet having an interior;
   a protective hood lining said interior;
   a support panel disposed within said protective hood; and
   a custom fitting system disposed outside of said

protective hood and operationally coupled to said support panel through said protective hood, said custom fitting system preferably adjusting the relative position between said support panel and said helmet.

2. The system of claim 1, wherein said custom fitting system is pivotably connected to said support panel and wherein said protective hood is sealed around the pivotal connection, said custom fitting system preferably comprising:

straps pivotally connected to said support panel; and
strap retaining clips mounted to said helmet.

3. The system of claim 1 or claim 2, wherein said support panel comprises a nape panel, and wherein said custom fitting system preferably adjusts the front-to-back position of said nape panel relative to said helmet.

4. The system of any preceding claim, further comprising a brow pad disposed within said protective hood.

5. The system of any preceding claim, wherein said support panel comprises a crown panel, custom fitting system preferably adjusting the height of said crown panel relative to said helmet, and/or said crown panel preferably comprising webbing strips with a gap formed therebetween.

6. The system of claim 5, comprising a crown duct equipped with an exhaust vent directed toward the gap, said hood preferably being sealed around said crown duct.

7. The system of claim 5 or claim 6, wherein said crown panel creates a space between said protective hood and a wearer's head, and preferably comprising a crown duct equipped with an exhaust vent directed toward the space, the hood preferably being sealed around said crown duct.

8. The system of any preceding claim, wherein said helmet includes a visor having an interior surface and a periphery and said protective hood is sealed to said visor periphery, said visor preferably including a visor duct along at least a portion of said visor periphery, and wherein said visor duct is equipped with vent holes directed toward the interior surface of said visor.

9. The system of any preceding claim, further comprising a respiration system including a stiff outer shell equipped with a breathing air supply hose and an exhalation valve, wherein said outer shell overlies a portion of said protective hood, preferably a portion disposed below said visor, and wherein said protective hood preferably seals around said breathing air supply hose and said exhalation valve.

10. The system of claim 9, wherein said respiration system additionally includes an adjustable length strap removably coupled between said outer shell and said helmet.

11. The system of any preceding claim, wherein said outer shell is equipped with a microphone cable, wherein said protective hood seals around said microphone cable, and/or said outer shell is equipped with a drink tube, wherein said protective hood seals around said drink tube, and/or said helmet includes earphones having communications cables, wherein said earphones are disposed within said hood and said hood is sealed around said communications cables.

12. The system of claim 1, further comprising a respiration system including a stiff outer shell and an inner facepiece adapted to enclose a mouth and nose of a wearer, wherein said stiff outer shell and said inner facepiece sandwich a portion of said protective hood therebetween, said respiration system preferably including a breathing air supply hose and an exhalation valve, wherein said protective hood seals around said breathing air supply hose and said exhalation valve.

13. The system of any preceding claim, wherein said protective hood has a lower edge, and comprising an elastic neck dam connected near said lower edge of said protective hood, and/or a shoulder shroud connected to said lower edge of said protective hood.

14. The system of any preceding claim, wherein said protective hood is made from a chemical resistant and biological resistant material that is molded to the shape of the helmet interior.

15. A fitting assembly for a helmet comprising:

an inner helmet positionable in a fore and aft direction and including interiorly a front forehead dome and side sections;
a rear panel adapted to contact the wearer's nape and means coupling said rear panel to said side sections for adjustably positioning said inner helmet in the fore and aft direction;
a contoured pad adapted to support the dome on the wearer's forehead; and
a protective hood lining the interior of said inner helmet.

16. The assembly of claim 15, wherein said contoured pad comprises a primary layer molded to the contours of the wearer's forehead, said primary layer preferably comprising an expanding foam compound having an initial liquid state and a final, cured solid state, said compound preferably being introduced in the initial liquid state into a gap formed between said dome and the wearer's forehead and wherein said compound expands to substantially occupy the gap in the final, cured solid state.

17. The assembly of claim 16, further comprising an inner layer of compressible material disposed between said primary layer and the wearer's forehead said contoured pad preferably further comprising an outer impact absorbing layer disposed between said primary layer and said dome, said inner and outer layers preferably cooperatively forming a receptacle for containing said primary layer.

18. The assembly of claim 16, wherein said contoured pad further comprises a pouch made of a material adapted for skin contact, wherein said pouch encases said primary layer, said inner layer and said outer layer.

19. The assembly of any of claims 15 to 18, wherein said coupling means comprises straps on said rear panel and retention clips on said inner helmet, said rear panel straps preferably being pivotally connected to said rear panel, and said rear panel preferably comprising a semi-rigid material.

20. The assembly of claim 41, wherein said rear panel straps pivot to engage said clips and upon tightening, said rear panel straps are adapted to flex said rear panel to the profile of the user's nape.

21. The assembly of any of claims 15 to 20, further comprising a chin strap attached to lower regions of said side sections, wherein said chin strap and said contoured pad and said rear panel form a three-point restraint which cooperatively resists forward rotation of the helmet, and/or comprising a breathing mask attached to lower regions of said side sections, wherein said breathing mask and said contoured pad and said rear panel form a three-point restraint which cooperatively resists forward rotation of the helmet

22. The assembly of any of claims 15 to 21, wherein said rear panel is disposed within said protective hood, and/or said contoured pad is disposed within said protective hood, and/or said rear panel coupling means is disposed outside said protective hood.

23. The assembly of any of claims 15 to 22, further comprising: a crown pad adapted to contact the wearer's crown, wherein said inner helmet in additionally positionable in a vertical direction; and means coupling said crown pad to said side sections for adjustably positioning said inner helmet in the vertical direction.

24. The assembly of claim 23, wherein said coupling means comprises straps on said crown pad and retention clips on said inner helmet, crown pad straps preferably being pivotally connected to said crown pad, said crown pad preferably being made of a semi-rigid material.

25. The assembly of claim 24, wherein said crown pad straps pivot to engage said clips and upon tightening, said crown pad straps are adapted to flex said crown pad to the profile of the user's crown.

26. The assembly of any of claims 23-25, wherein said crown pad is disposed within said protective hood, and/or said crown pad coupling means is disposed outside of said protective hood.

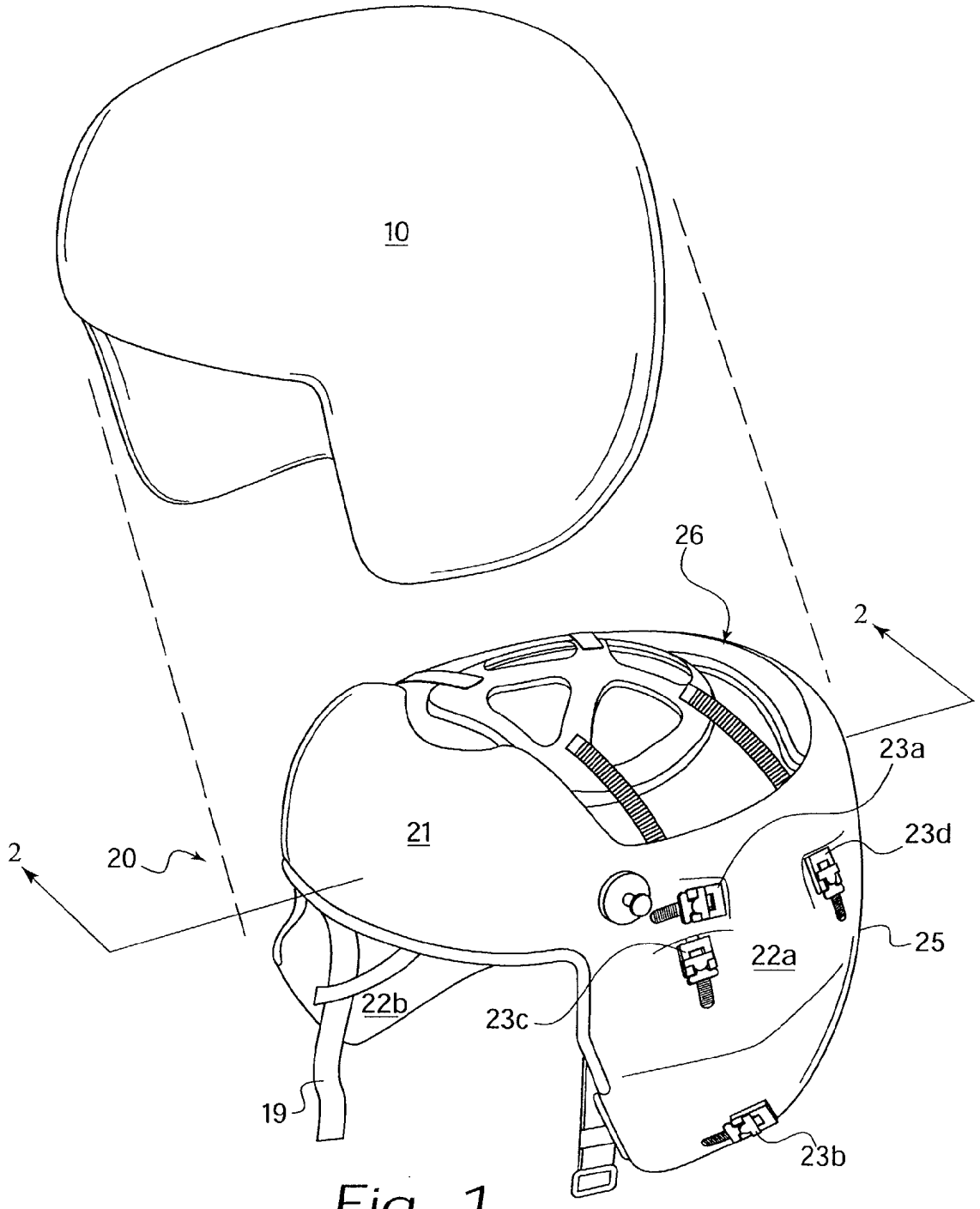


Fig. 1

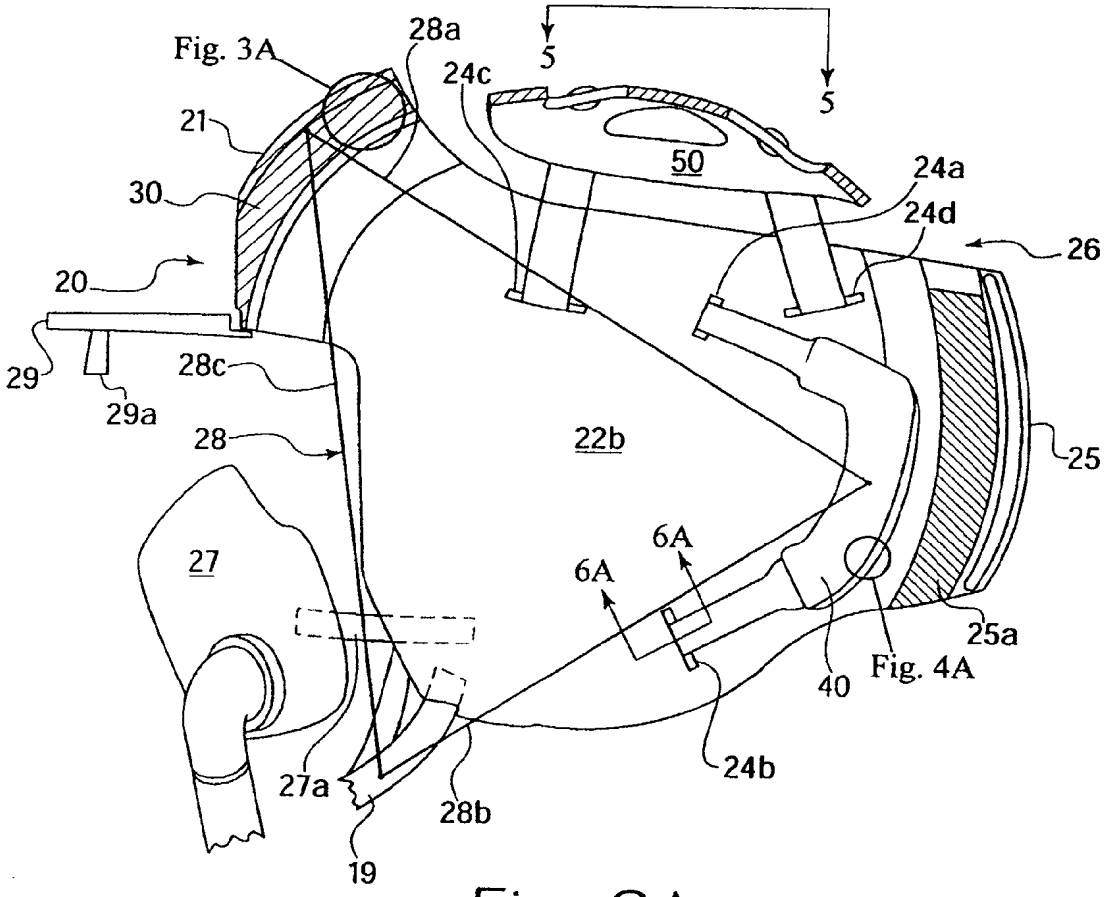
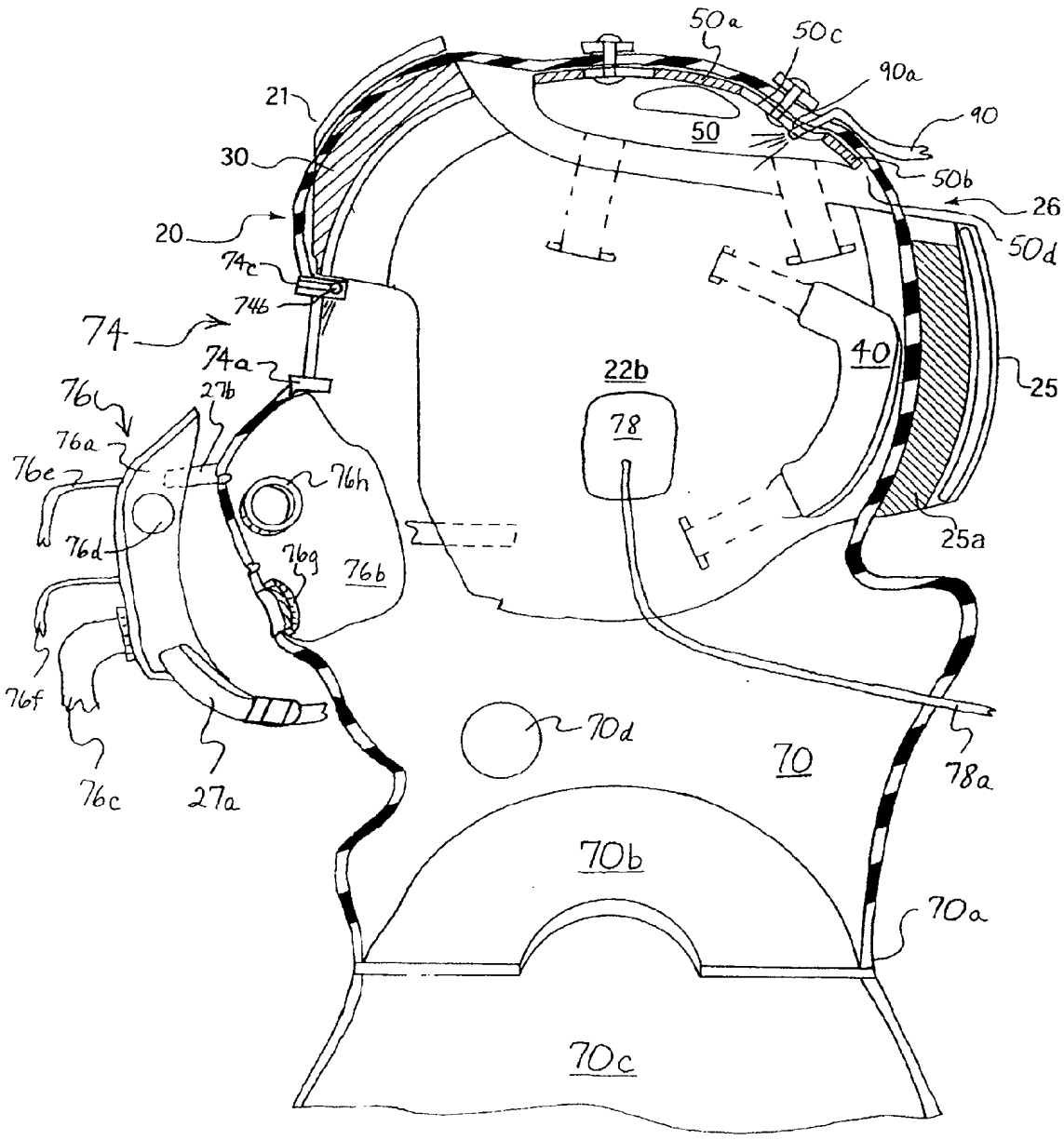


Fig. 3A
28a
5
5
24c
21
50
24a
30
24d
26
20
29
28c
29a
28
22b
25
27
6A
6A
25a
Fig. 4A
40
24b
27a
28b
19

Fig. 2A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90a
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50
30
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27b
78
76a
76e
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70c

Fig. 2B

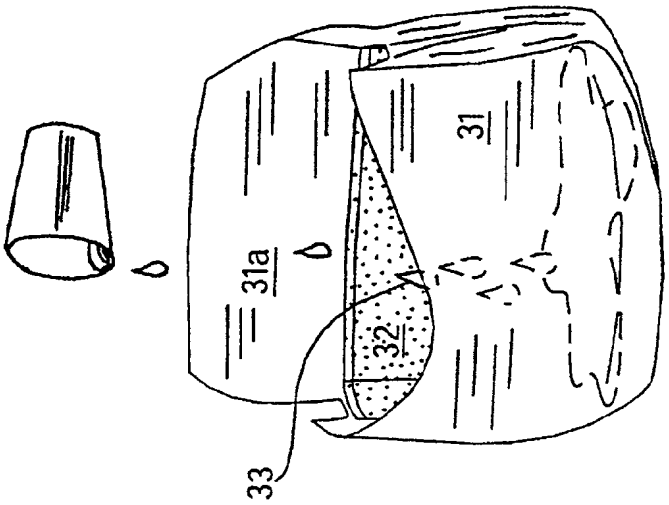

Fig. 3B

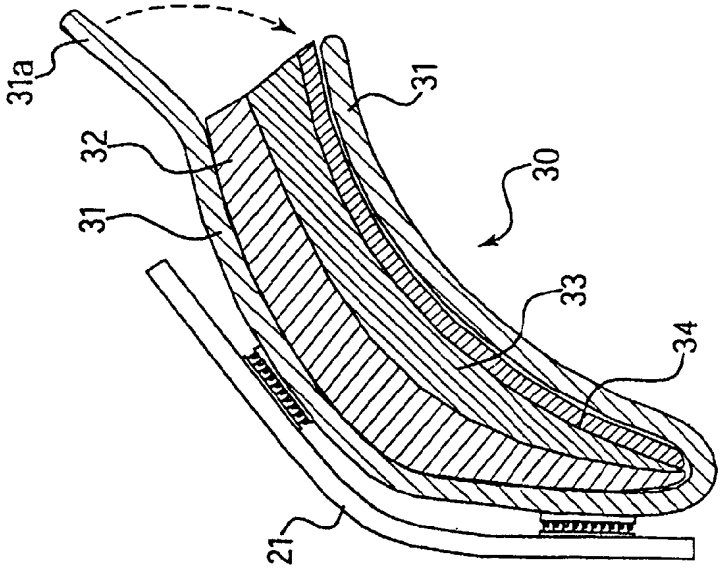

Fig. 3A

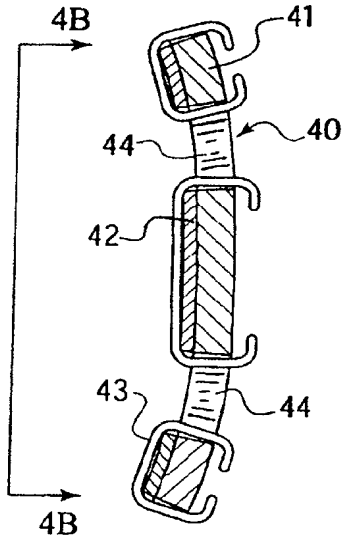

Fig. 4A

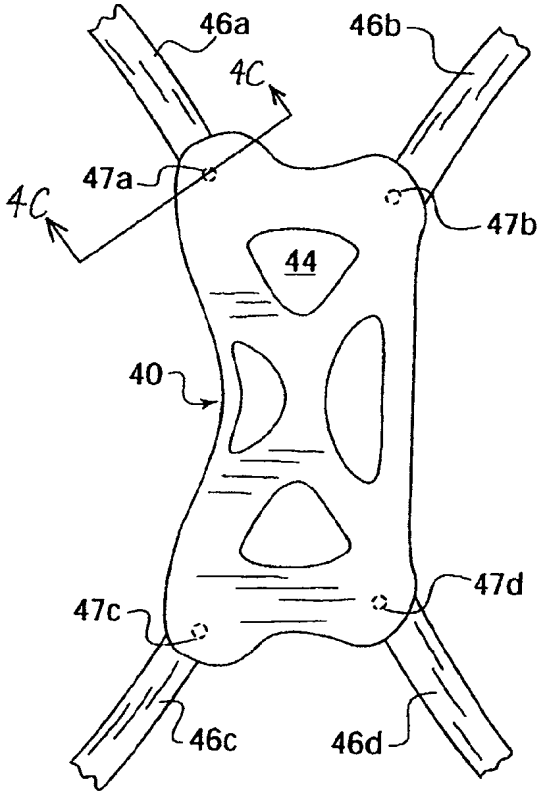

Fig. 4B

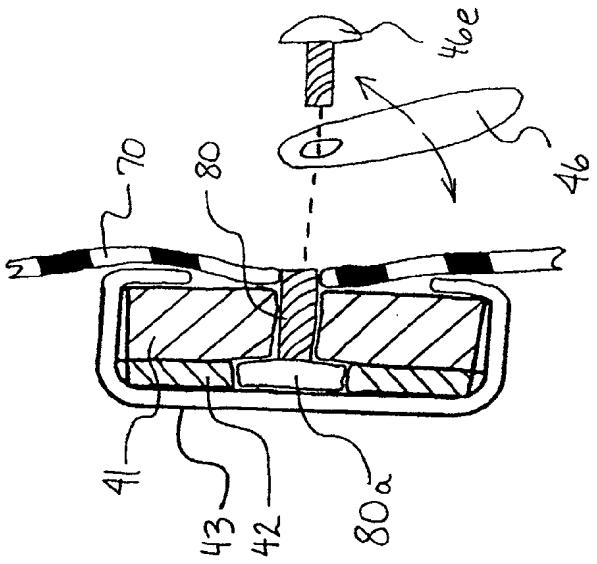

Fig. 4C

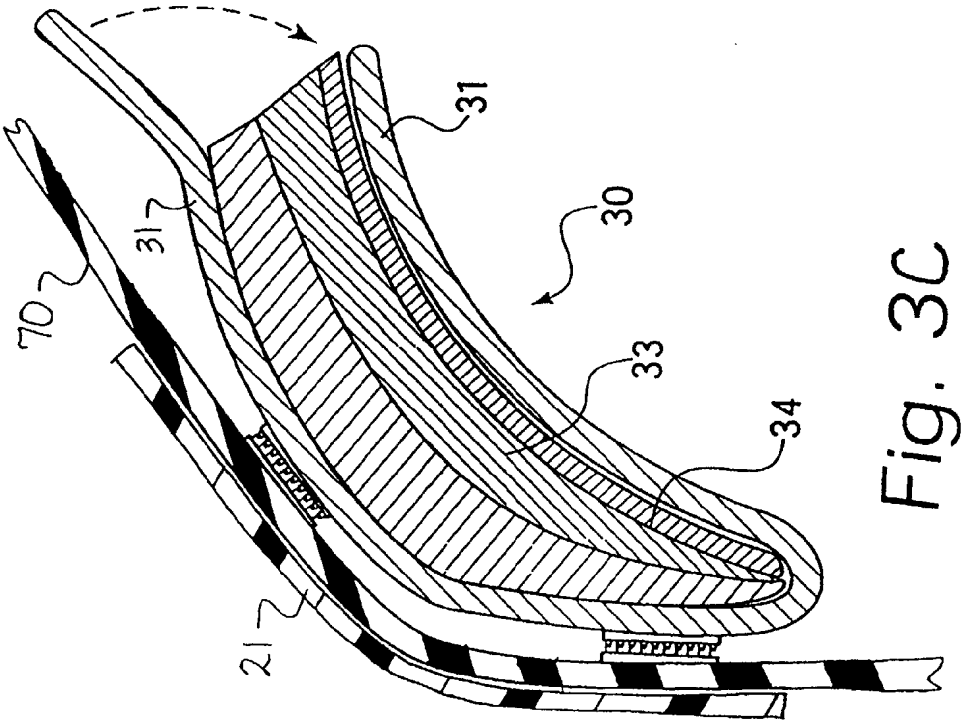

Fig. 3C

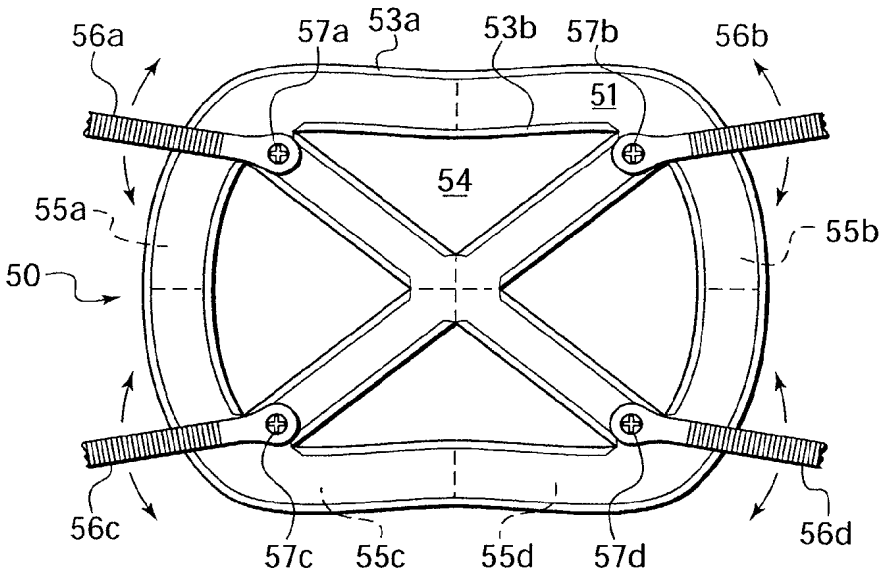

Fig. 5

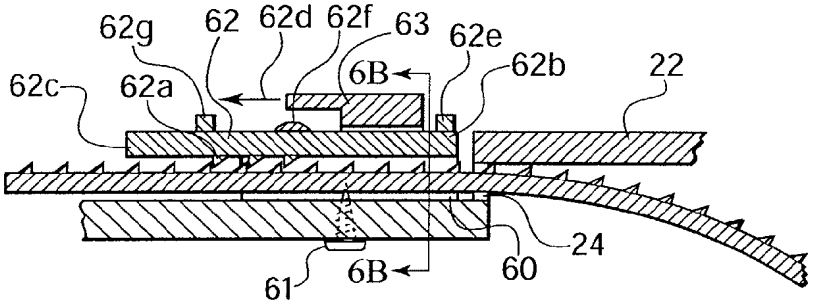

Fig. 6A

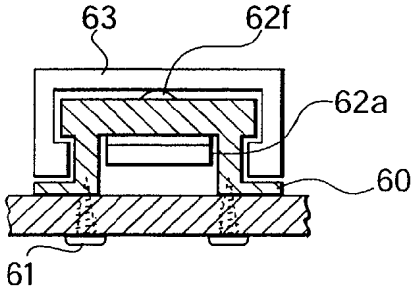

Fig. 6B